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(54) Assembled cylindrical roll tool with axially extending joint between parts

(57) The assembled tool comprises a roll having functional body rings 2 replaceably fitted onto the moment transmitting external surface of a repeatably usable basic body 1, the strength of material of said rings being adaquate to the loads.

The assembled rolls comprise functional body rings secured around the basic body solely by close fitting interengaging mutually complementarily shaped, preferably polygonal, surfaces on the said bodies.

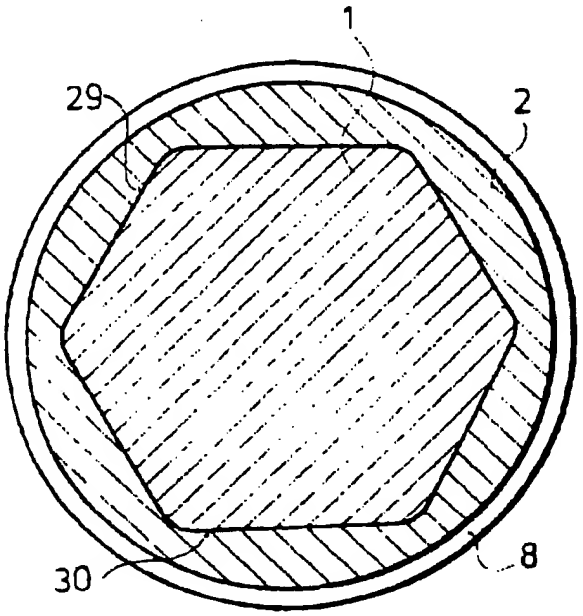

Fig. 10

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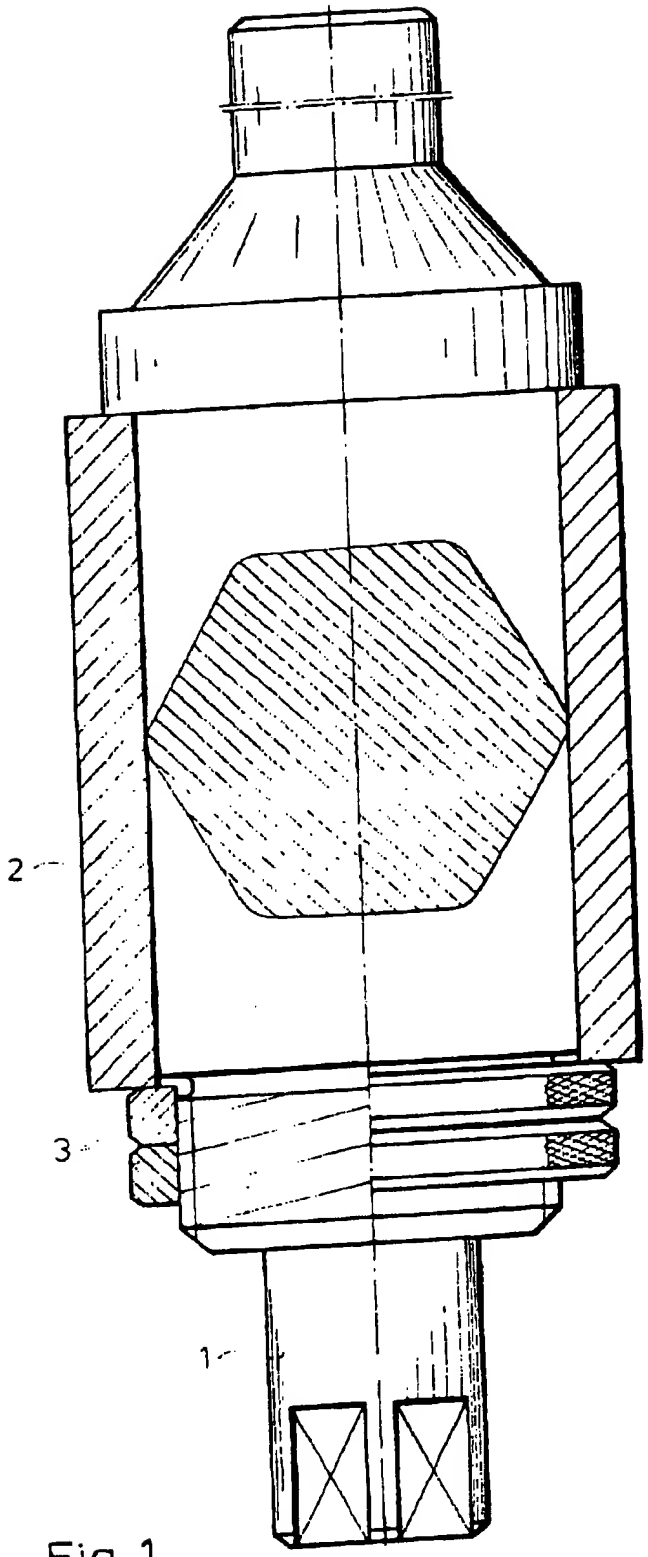

Fig. 1

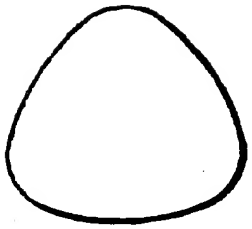

Fig.2

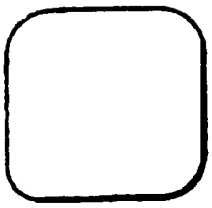

Fig.3

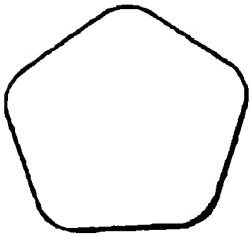

Fig.4

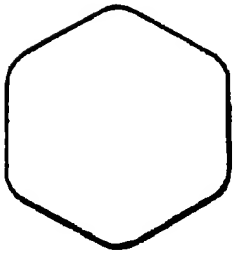

Fig.5

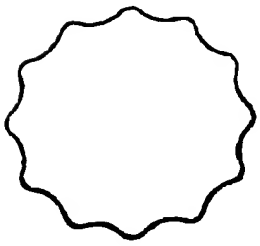

Fig.6

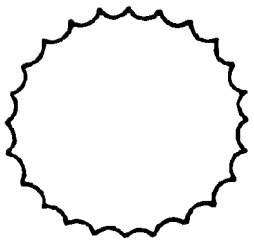

Fig.7

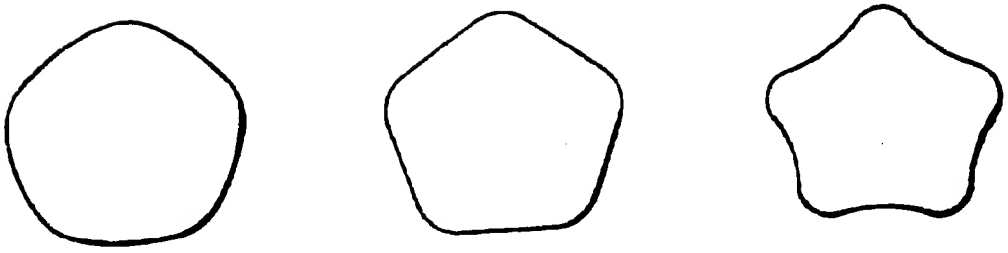

Fig.8

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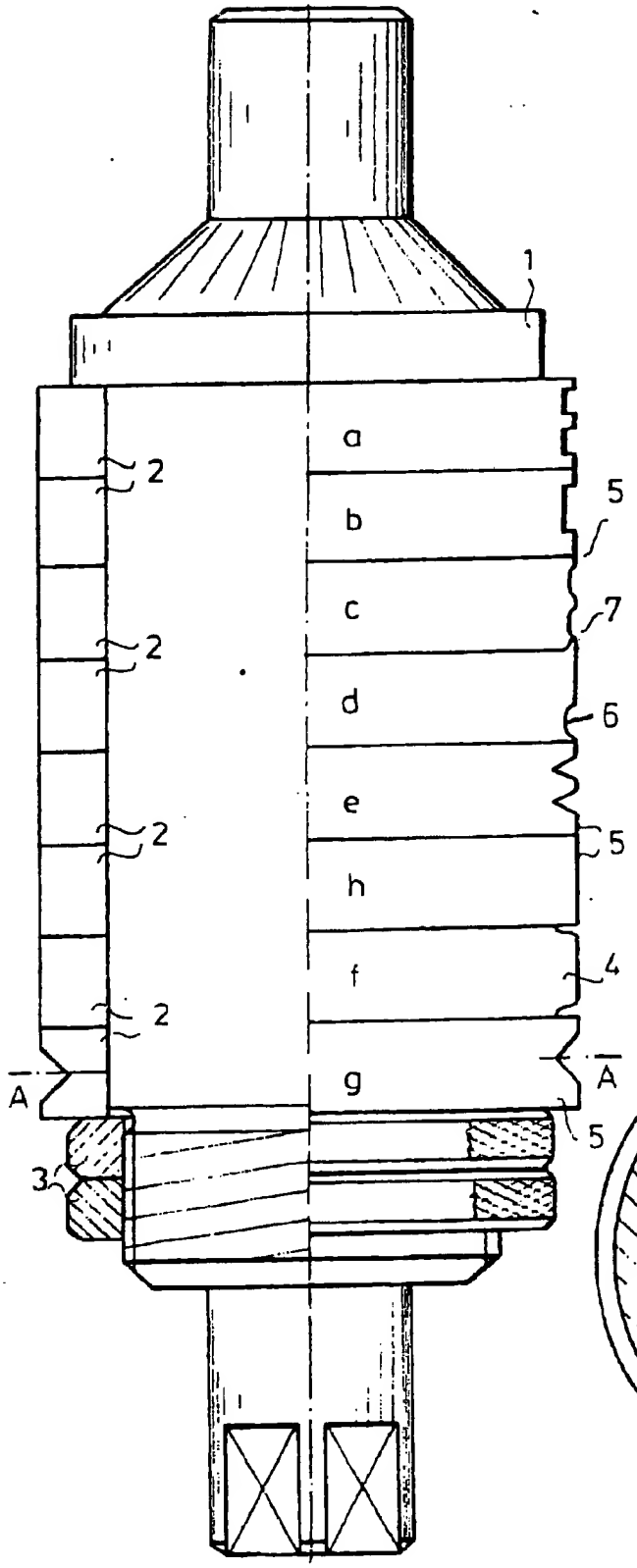

Fig. 9

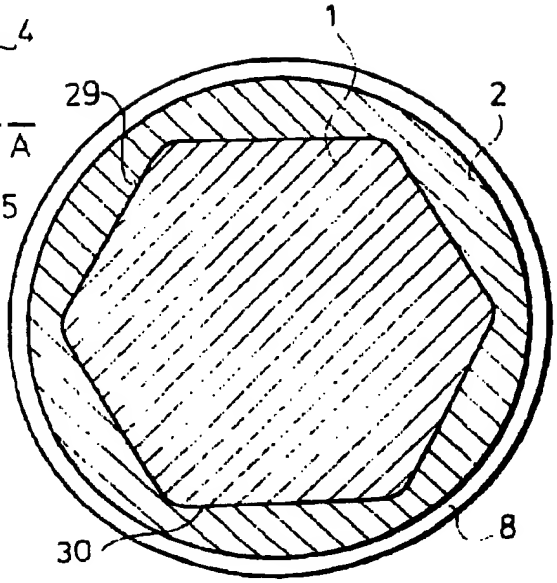

Fig. 10

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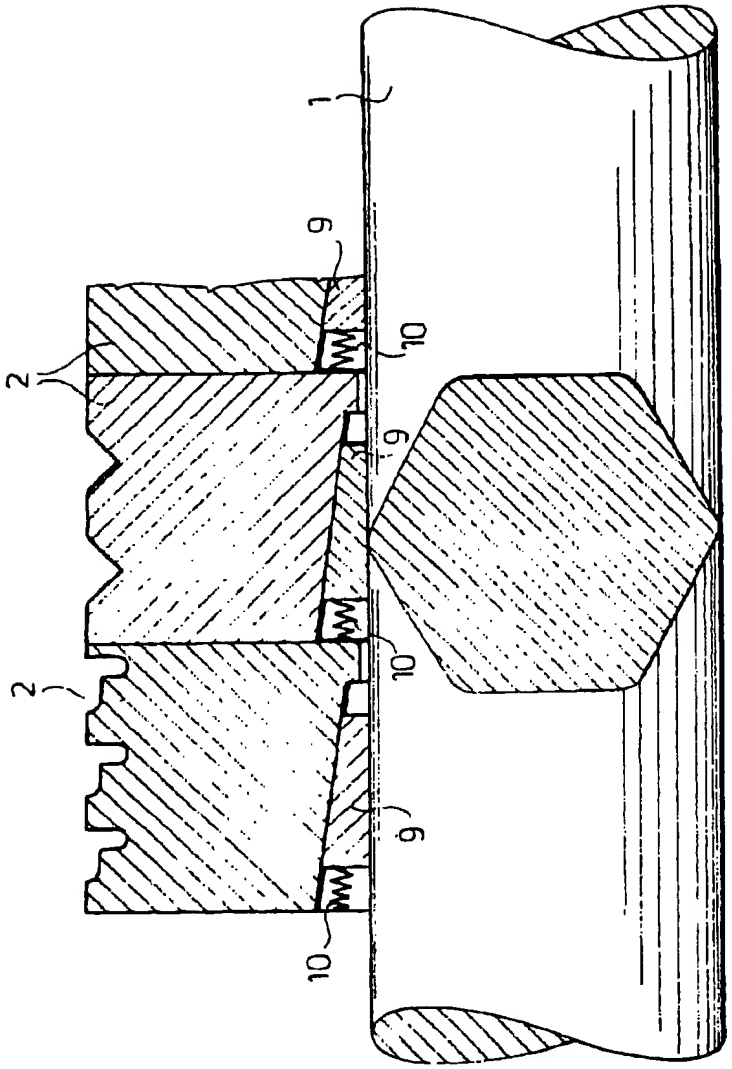

Fig.11

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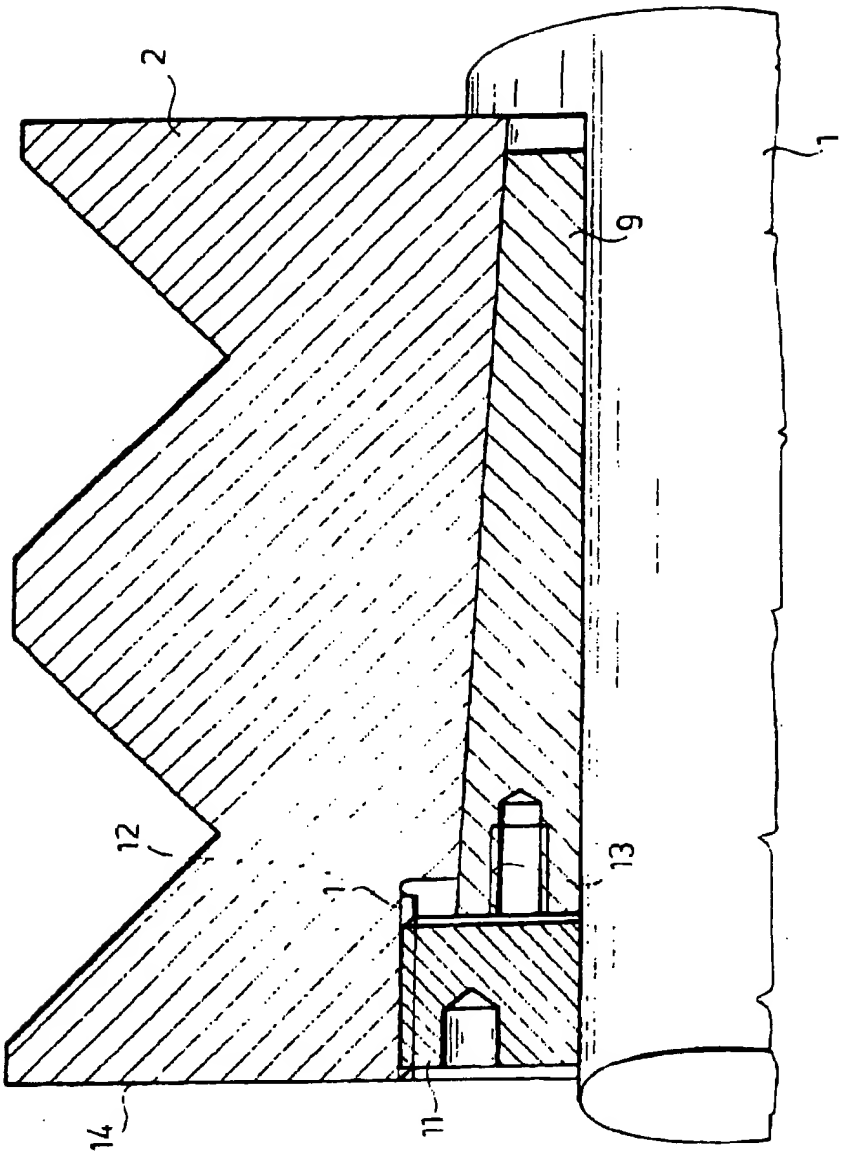

Fig.12

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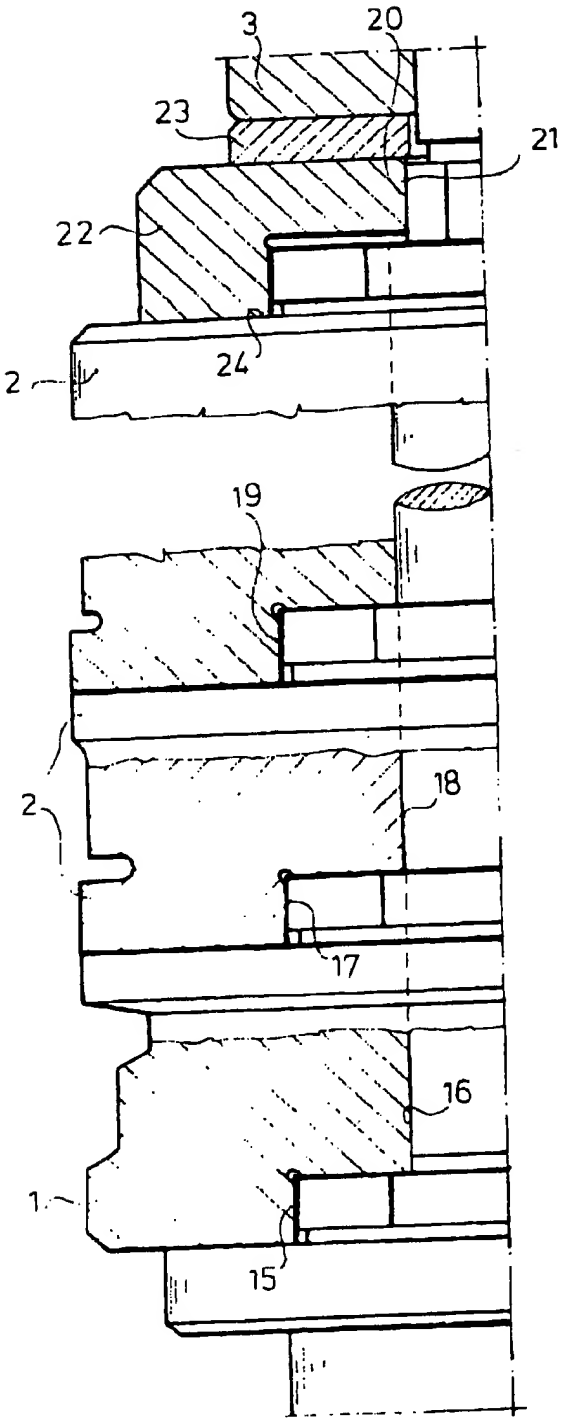

Fig. 13

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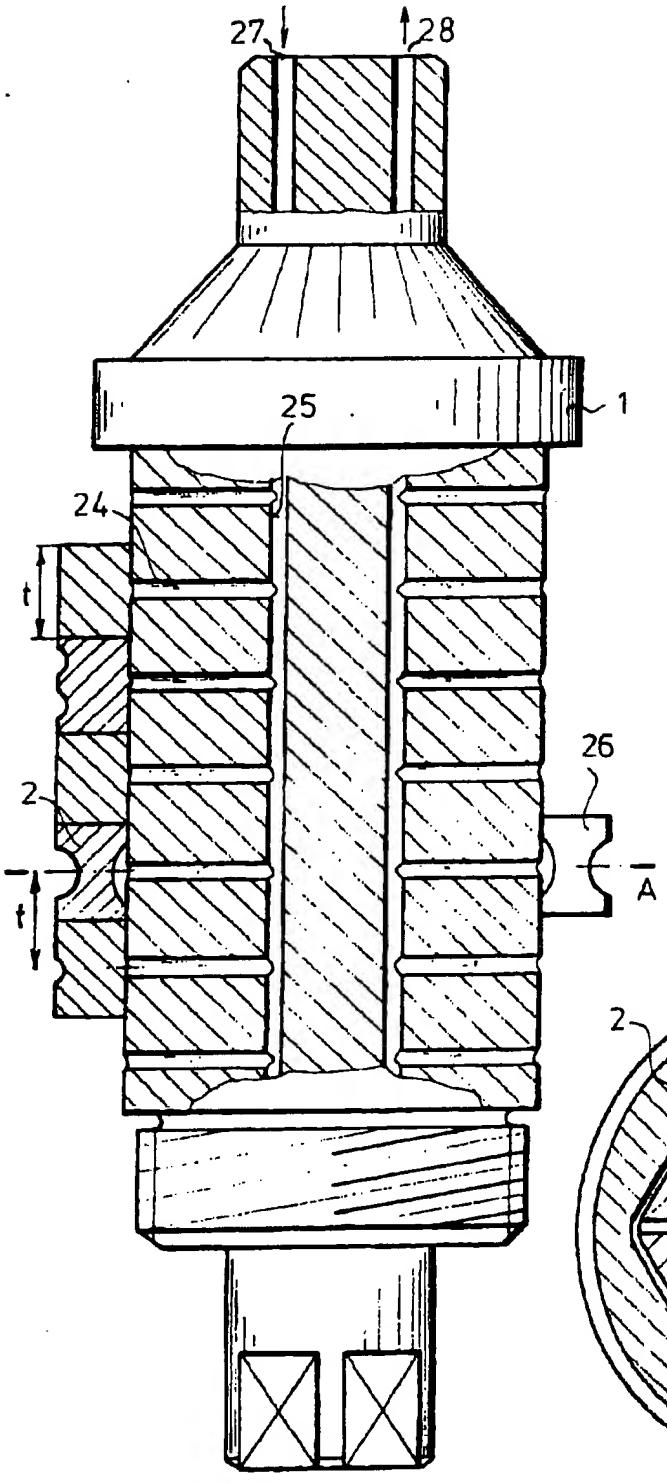

Fig. 14

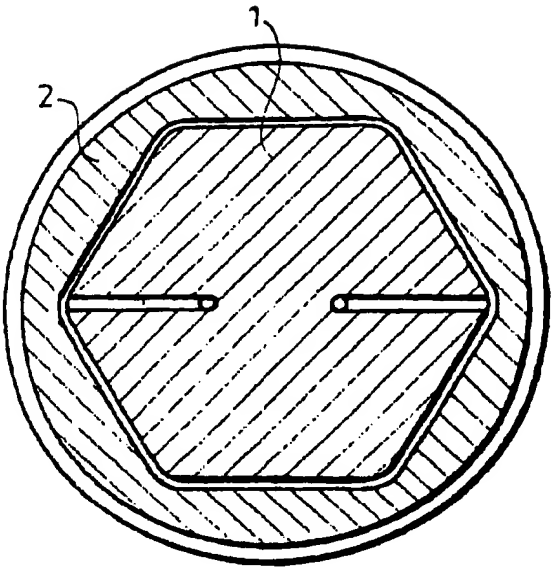

Fig. 14a

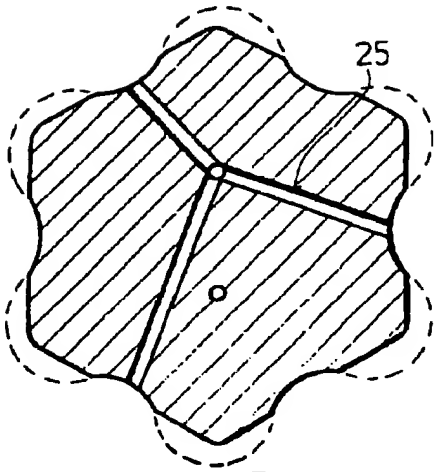

Fig.15c

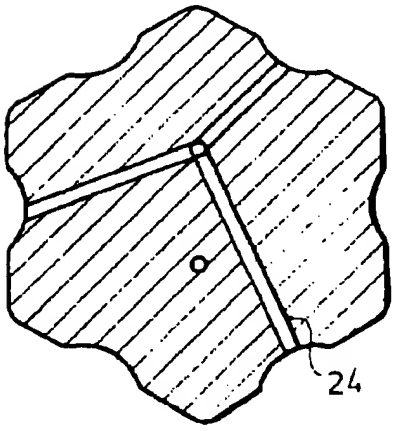

Fig.15b

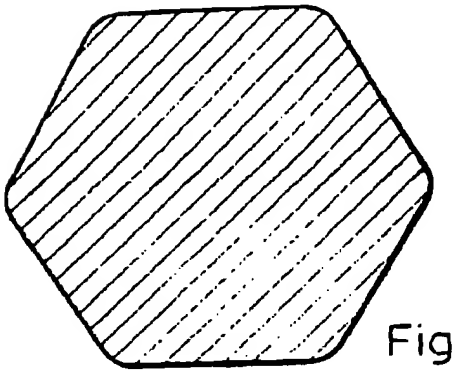

Fig. 15a

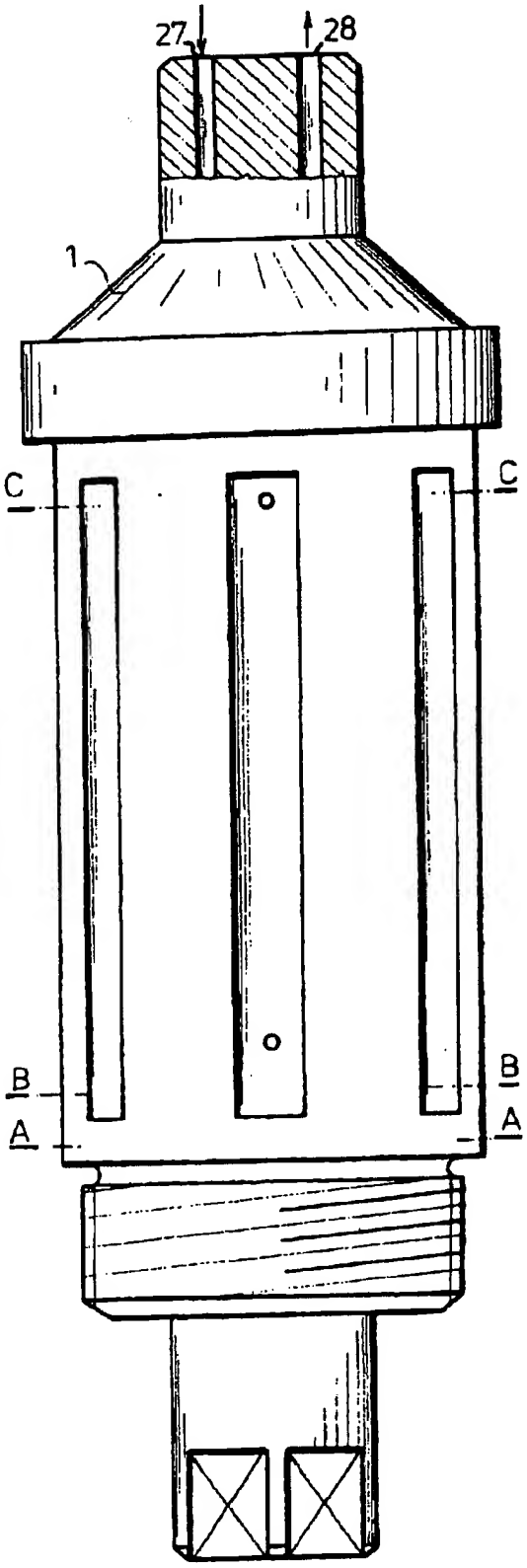

Fig. 15

SPECIFICATION

Divided, assembled cylindrical tool with true to shape joint

The apparatus representing the subject of the invention is a shaping cylindrical tool, which has been developed more expendiently than any other earlier used tool for the same purpose, and it has a favourable modification effact on the production technology as well.

The existing cylindrical tools suitable for shaping, breaking are formed from a single piece. This involves disadvantage in that part of the tool near the surface, i.e. the working body has to be wear resistant, and its material has to be selected accordingly. The intermediate part, i.e. the basic body is exposed to bending stress, it transmits the moment, hence it requires tough material. Owing to the formation from a single piece, the selection of the material maximally suitable for the two different loads is not possible. Further drawback is that the worn functional body can be repaired only to a limited extent, its total wear amounts to the wear of the basic and functional body, i.e. to the totality of the tool.

Hence according to the new methods the functional body machined as ring is fixed separately to the basic body. In case of such solution the functional body is hard, wear resistant, the basic body is tough, made of material for taking up high load and suitable for moment transmission.

Fixing of the ring is solved with sticking, screw joint and hydraulic tension. The hydraulic tension is attained by formation of a cavity in the basic body. The hydraulic fluid is conducted into this cavity, the pressure of which presses the jacket of the basic body against the interior of the ring(s) (functional body).

The solution has its drawbacks. The moment transmission is brought about through the friction force and at given dimensions a moment of restricted magnitude can be transmitted. Therefore these solutions are favourable only in case of shaping that requires only small moment. The fastening requires additional operation (sticking, screwing, hydraulic tensioning), and operation of the mounting and dismounting is time-consuming. In case of screw thread and hydraulic joint the geometry of the basic body is more complicated. Cooling of the cylindrical tool can be accomplished only with external cooling, the same way as in case of the tool machined from a single piece.

The formation of the cylindrical tool according to the invention is aimed at elimination of these drawbacks.

Purpose of the invention is the realization of such cold and hot working assembled roll-train which is suitable for all traditional rolling work with the required accuracy and productivity, where the tooling cost is reduced with the use of suitable material and production technology, the life of the rolls is extended considerably, the basic body and functional bodies can be used again and it represents significant saving of the tool material.

The fundamental idea of the invention is that the moment transmission between the assembled basic body and functional bodies (rings) takes place with a true to shape joint.

The assembled roll according to the invention realizes the objective of the invention in that functional body, or bodies, rings fitted onto the moment transmitting surface system are arranged on the external surface of the basic body with strength sufficient for the loads, the functional surface layers of which are fixed and made with the required functional characteristics.

Further characteristics of the assembled roll according to the invention is that it is provided with shoulder for fixing the functional bodies (rings), which is larger than the moment transmitting surface system, but smaller than the outside diameter of the functional body (ring), and it has a threaded part for fixing.

Further characteristic of the assembled roll according to the invention is that spacing of the functional body (ring) can be selected (e.g. in the cavity) according to the purpose of the production, operation and renovation.

Further characteristic of the assembled roll according to the invention is that conical split casing is between the basic body and the threaded ring (spring) for tensioning.

Further characteristic of the assembled roll according to the invention is that polygonal surface for the moment transmission and highly accurate cylindrical surface for the guiding are on the basic body, accordingly the inner surface system of the functional body (ring) is complex, provided with polygonal and cylindrical hole suited to the one selected on the basic body.

Further characteristic of the assembled roll according to the invention is the number, size, material of the functional bodies can be selected optionally according to the purpose.

Further characteristic of the assembled roll according to the invention is that the basic body is provided with cooling hole system, and cooling groove on the adjoining surface of the functional body.

Finally further characteristic of the assembled roll according to the invention is that the functional bodies can be produced anywhere separately from the basic body, and with suitable selection a programmed tool can be assembled.

The cold and hot woring roll-train according to the invention is described in detail in connection with the construction given by way of example, with the aid of the enclosed drawings, in which:

Figure 1. Assembled roll with functional body (ring) and polygonal joint.

Figure 2. Section of the moment transmitting triangular polygonal profile formed between the assembled basic body and functional bodies.

Figure 3. Section of the moment transmitting quadrangular polygonal profile formed between the assembled basic body and functional bodies.

Figure 4. Section of the moment transmitting pentagonal profile formed between the assembled basic body and functional bodies.

Figure 5. Section of the moment transmitting hexagonal profile formed between the assembled basic body and functional bodies.

Figure 6. Section of the moment transmitting dode-cagonal profile formed between the assembled basic body and functional bodies.

Figure 7. Section of the moment transmitting twenty-five angular polygonal profile formed between the assembled basic body and functional bodies.

Figure 8. Different forms of the pentagonal profile.

Figure 9. Diagram of the programmed tool with several functional bodies (rings).

Figure 10. Section of the basic body and functional body along line A-A in Fig. 9.

Figure 11. Diagram showing the fastening of the assembled body and functional body (ring)

Figure 12. Alternative solution of the fastening shown in Fig. 11., with threaded joint.

Figure 13. Diagram of the assembled roll with combined joint

Figures 14 and *14a* show a cooling system of the assembled roll formed with internal grooved functional body (ring), Fig. 14a being a section along line A-A of Fig. 14.

Figures 15, 15a, 15b and *15c* show a cooling system of the assembled roll with groove along the generatrix.

In the construction shown in Fig. 1. the basic body 1 has polygonal cross section and provided with shoulder, threaded jacket surface and functional body (ring) with polygonal hole. The functional body 2 is pulled over the basic body, then fixed and secured with threaded nuts 3, and when the functional body becomes worn, the threaded nuts 3 are removed, the functional body is replaced and fixed again with the nuts 3.

Fig. 2. shows traingular cross section, which in case of small moment transmission is suitable for the moment transmission of the basic body and functional body. Its favourable property is that even in case of elements fitted with clearance, the functional body 2 sits centally on the basic body 1 (self-centering).

Fig. 3. shows quadrangular cross section used for small moment transmission with fit free from play.

Fig. 4. shows a pentagonal cross section used for high roll pressures, since for odd-numbered angular profiles the load bearing cross section is nearly identical (not much difference between the peak face distance and sections in between, as for instance at the quadrangular cross section, where the face distance and peak distance are considerably different.)

Fig. 5. shows a hexagonal cross section, which is used suitably for rough rolls, where the moment to be transmitted is better distributed on the greater number of sides.

Fig. 6. shows a dodecagonal cross section used suitably for the joint of cold working fine rolls, since the loads are low at the fitting free from play.

Fig. 7. shows a twentyfive angular cross section used suitably for the joint of reversible rolls in case of extreme load for distribution of the load.

Fig. 8. shows the differently formed shape of the pentagonal profile. The side formation of the polygonal profiles may be concave, nearly straight, and convex. By increasing the number of angles the extent of the moment to be transmitted is reduced for each side.

In case of given number of angles the profile is to be selected according to its use for cold or hot rolling. In case of hot rolling the fits vary during operation. On account of the play the jacket surface pressure is the most favourable at nearly straight sided profiles.

The material utilization is best at cold rolling in case of slightly convex profiles. The moment transmission acts along the total circumference. The concave formation is justified for less accurate joint (turned), the straight side formation for great moment transmission (where the the jacket pressure is critical) when fitted with clearance in case of hot rolling, while the convex formation in case of cold rolls free from play.

Fig. 9. shows an assembled programmed tool. The programmed tool is an assembled roll, where the functional bodies can be used in the number and variety according to the production programme, as for the simultaneous production of such diversified products. When the production programme is changed the functional bodies 2 are dismantled from the basic body 1 by removing the threaded nuts 3 and it is reassembled with shaping bodies according to the new jobs. The functional body 2 of the assembled tool can be divided. The functional body 2 can be divided in case of shaped roll along the cavity, when the dividing plane (4) falls into the shaped cavity, or outside the cavity (5), or one of the dividing planes falls into the cavity (6) and the other dividing plane outside the parting (7).

Fig. 10. shows the cross section (section A-A, Fig. 9.) of the assembled roll. The polygonal hole (30) of the functional body 2 joins the polygonal profile (29) of the basic body 1 with trueness to shape, and the section of the

cavity 8 on the outer shaping surface of the functional body.

Fig. 11. shows the diagram of a conical case-fastening for elimination of possible dimension variations due to the loads. The functional bodies 2 are fitted with a split conical sleeve 9 to the polygon shaped surface system of parallel generatrix of the basic body 1. The wedging fit of the conical sleeve 9 is ensured by the forces of spring 10, thus preventing undesirable plays.

Fig. 12. shows the diagram of a solution similar to the conical sleeve fastening illustrated in Fig. 11., where the functional bodies 2 can be fixed with threaded ring and free from play into the basic body 1. The conical sleeve 9 is placed into the internal conical polygonal hole of the functional bodies 2 until it is contact with the shoulder of the basic body 1, then the threaed ring 11 is crewed into the internal thread 12 of the functional body 2 until the conical sleeve 9 is wedged in. During disassembly the threaded ring 11 is unscrewed and screwing the removing screw in contact with the face (14) of the functional body into the threaded hole (13) of the conical sleeve 9 it is pulled out and the functional body 2 is dismounted from the basic body 1.

Fig. 13. shows the diagram of such assembled roll, where—in addition to the shoulder for contact and the threaded part for fastening—the basic body 1 is provided with moment transmitting polygonal surfaces (15, 20) and with a cylindrical jacket surface 16. The functional body 2 has a polygonal hole 17 joining the polygonal jacket 15 of the basic body, a cylindrical hole 18 joining the cylindrical jacket surface (16), as well as a polygonal jacket surface 19 adjoining the polygonal hole 17 of the divided functional body. This joint is called combined joint. The assembled rolls with combined joint realize a highly accurate joint, thus the cubic capacity of the rolls is reducible (e.g. fine rolls)—The functional bodies 2 are arranged on basic body 1 (according to diagram 13.), so that the polygonal hole 17 and the cylindrical hole 18 are fitted to the polygonal pin 15 and to the cylindrical jacket 16 of the basic body. The polygonal hole 17 of the next functional body is connected to the polygonal pin 19 of the former functional body. After placing the last functional body onto the basic body 1, the driving disc 22 is fitted into the polygonal surface 20 at the threaded end of the basic body 1 and into the polygonal pin 19 of the functional body and it is contacted with the face (24) of the functional body. In the next step it is compressed with the threaded rings 3 through washer 23 and fixed. In case of replacement dismounting of the shaping bodies is carried out in reversed order.

Fig. 14. shows the diagram of the cooling system of an assembled roll given by way of example. The basic body 1 is provided with two axially parallel holes 25 and with radially arranged holes 24 the number of which correspond to the spacing t of the functional bodies 2, the purpose of these holes is to guide the coolant into the cooling manifold 26 formed on the inner surface of the functioning body 3. The special advantage of the solution is that cooling of the shaping bodies 2 according to the necessity is solved in such a way, that the distributing duct system is arranged on the basic body 1, which is not changed when the functional bodies are replaced. The cold coolant passes through the inlet hole 27 of the cooling duct into the roll, which circulates in the internal hole of the functional body and passes out through the outlet hole 28.

Figs. 15, and Figs. 15*a* to *c*, being cross-sections along lines A-A, B-B, and C-C in Fig. 125, show the basic body with grooves along the generatrix, where the inlet and outlet hole system adjoins the said grooves. The inlet and outlet hole of the coolant in the groove are such that the coolant flows in opposite direction in the successive grooves along the jacket, thus the cooling along the roll is uniform. The inlet and outlet connections are fitted to the grooves independently from the parting of the functional bodies. Since all cooling ducts are formed on the basic body, arrangement of the cooling grooves on the functional bodies is unnecessary, the solution is applicable for functional body of any profile or system independently from the parting.

The assembled rolls according to the invention are produced vary economically with the existing universal production equipment. The novel polygonal joints can be economically produced with the polygonal machining equipment. The functional bodies of the assembled rolls can be produced separately from the basic body made of material and according to the method suited to the loads.

CLAIMS

1. Divided assembled roll with true to shape joint, consisting of basic body (1) and functional body (2) arranged on it, characterized in that true to shape joint (29,30) is between the basic body (1) and functional body (2).

2. Roll as claimed in claim 1., characterized in that the true to shape joint has harmonic (without notch) polygonal surfaces adjoining each other.

3. Roll as claimed in claim 1., or 2., characterized in that the functional body (2) has at least one hollow ring (5) which is divided through the cavity (6) (Fig. 9.).

4. Roll as claimed in any of claims 1–3., characterized in that the basic body has polygonal cross sectional parts (15, 20) on both ends and within these a cylindrical part (16), furthermore there is at least one functional

body (2) provided with polygonal moment transmitting hole (17) and adjoining cylindrical matching hole (18), as well as with polygonal moment transmitting pin (19) adjoining the matching hole (Fig. 13.).

5. Roll as claimed in any of claims 1–4., characterized in that ring (9) with conical fit is between the basic body (1) and functional body (2).

6. Roll as claimed in claim 1–5., characterized in that cooling ducts (24,25) are formed in the basic body (1) for guiding the coolant to the adjoining surface of the basic body.

7. Roll as claimed in claim 6., characterized in that the cooling ducts are axially distributing ducts (25) and radial ducts (24) leading from the former ones to the surface (Fig. 14.).

8. Roll as claimed in claims 6., and 7., characterized in that the radial ducts (24) lead into the axial surface ducts ''29) (Fig.15.).

9. Roll as claimed in claims 6.–8., characterized in that cooling tower (26) in communication with the cooling ducts (24,25) of the basic body (1) is formed on the adjoining surface (30) of the functional body (2).

10. A roll assembly for working materials comprising an internal basic body, and an external functional, workpiece-engaging body which is secured to and around the basic body solely by closely-fitting, interengaging, mutually complementarily shaped, polygonal surfaces on the said bodies.

11. A roll assembly substantially as herein described with reference to and as shown in any of Figs. 1 to 8 or Figs. 9 and 10 or any of Figs. 11 to 13 or Figs. 14 and 14a or Figs. 15, 15a, 15b and 15c of the accompanying drawings.

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